Langley (S. P.)

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Transit of Mercury of May 6th, 1878; by S. P. Langley.

The following observations made during the transit of Mercury, yesterday, have some interest from the inferences to be drawn from them as to physical phenomena; and to devote the opportunity more wholly to this object, no measures of precision were attempted, beyond noting the times of ingress and egress. The principal instruments were the equatoreal refractor of thirteen inches (used in the early part of the day with nine inches effective aperture), and a polarizing solar eye-piece, which dispenses altogether with any dark glass, and presents objects in their natural colors and relative brightness.

I had the fortune, at ingress, of an unusually blue and transparent sky, and aided by this, saw with the polarizing eye-piece the entire disc of Mercury *outside* the sun about one-half a minute before first external contact. Presumably it might have been seen even earlier, had not time been lost in searching for it, through lack of means to designate the precise position-angle, the position filar-micrometer not being adaptable to this eye-piece. After a pause to verify the reality of the phenomenon by revolving the eye-lens, etc., the chronograph key was struck at $21^h\ 52^m\ 39^s{\cdot}45$ Allegheny mean time, to record the observation. As this was really made earlier, and the disc was seen throughout its circumference, it seems clear that the coronal back-ground is bright enough to produce this effect at least fifteen seconds of arc from the solar limb, and in spite of the atmospheric glare.

As a partial substitute for the filar micrometer, there was in the field a glass reticule, ruled (by Prof. Rogers, of Harvard) in squares whose sides represented here $15''{\cdot}3$, and this enabled —not a measurement—but a fair comparison to be made of the apparent size of the planet before and after it entered on the sun. The contrast was striking, as on a back-ground very little brighter than itself its diameter was, if anything, greater than one of the sides of these squares, while as soon as it entered on the sun it seemed to shrink by more than one-fifth of this. First external contact was noted on the chronograph at $21^h\ 52^m\ 50^s{\cdot}43$. First internal contact was noted when the sunlight could be seen unmistakably between the disc and limb at $21^h\ 55^m\ 47^s{\cdot}25$. These entries, I believe to have been made in both cases nearly two seconds late. The limb just at second contact, was steady. I saw no "black drop" or "ligament."

As the disc advanced on the sun it was closely scrutinized, without at any time any "bright point" or "annulus" being

seen. These appearances, resting as they do on much testimony, particularly the unimpeachable evidence of Mr. Huggins, I was prepared to expect, but fruitlessly looked for with powers varying from 120 to 800 throughout the day, with the polarizing eye-piece, and also by projection of the image. The phenomenon may depend for its visibility on exceptionally good definition, which Mr. Huggins* appears to have had; that here was fairly, though not unusually, good. The darkest part of the planet was the center, the edges being decidedly less gray. The cause of this gradation came out very clearly in forming a very enlarged image for projection, being plainly due in most part to minute and rapid atmospheric tremor. In moments of best definition the surface became of a nearly uniform shade throughout.†

The planet has been almost uniformly described as looking "black" in transit, but in the instrument I use (the objective of which was corrected by Mr. Alvan Clark), it certainly does *not* look black. The color is decidedly less red than that of spot nuclei, being gray, slightly inclining toward a blue, like that of the spectrum between F. γ. G. (It may be that this bluish cast comes from the secondary spectrum of the objective). The average light from the disc in transit is very considerable, being not much less than that of some nuclei. No spots were present for comparison, but being engaged in photometric determinations of these and other parts of the solar surface, I was provided with means of comparing Mercury with tints which had previously been contrasted with sun-spots under like conditions. Absolute photometric determinations of the apparent light from Mercury in transit were attempted by projecting a greatly enlarged image (its actual diameter was three-quarters inch as projected), on a white surface in a dark camera attached to, and moving with, the equatoreal. Direct measurements with a Jamin photometer were unsatisfactory. Subsequently, by another method, a trustworthy value was fixed for a minimum. It was thus found that the light actually received on the paper apparently from the so-called "black" body of the planet, at any rate exceeded eight per cent of that from direct sunlight, and measures taken by the thermopile and galvanometer showed that heat was coming from the same direction.

It need hardly be said that it is impossible that Mercury itself should be radiating heat and light in any such degree. Accordingly I take these numbers as representing (with some possible allowance for instrumental causes) the minimum effect

* Monthly Notices R. A. S., vol. xxix, p. 26.

† I presume that even in absolutely perfect definition there would be theoretically a slight gradation due to another cause, i. e., to the greater effect of the edge of the planet's disc of the inflection, referred to in a subsequent paragraph.

we can assign to our own atmosphere in inflecting the solar radiation, a subject on which data have been hitherto desirable. It is evident, for instance, that from the facts here stated we can estimate, photometrically, the intrinsic brightness of the corona, since it was undoubtedly this, acting as a back-ground, which enabled the planet, though itself involved to a calculable extent in atmospheric glare, to be seen before it reached the solar limb.

The observations were interrupted by haze in the afternoon and egress was so nearly invisible that the apparent times of contact are not worth giving.

Allegheny Observatory, May 7, 1878.